



# Storage Performance Council (SPC)

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# Presentations and Speakers

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- **The Storage Performance Council (SPC) update**  
Leah Schoeb (*Sun Microsystems, Inc.*)
- ***What is SPC-1?***  
Mel Boksenbaum (*Hitachi Data Systems Corporation*)
- ***What is an audited SPC-1 result, and how can I use it?***  
Walter E. Baker (*Gradient Systems, Inc.*)
- ***How to use SPC-1 results and what they mean to you.***  
Randy Kerns (*Evaluator Group*)
- ***Futures direction of the SPC and it's benchmarks.***  
Peter Dreisbach (*Adaptec, Inc.*)



# The Storage Performance Council (SPC)

Leah Schoeb



# Storage Performance is Important

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- Storage cost is 40-80% of total system cost.
- Storage bottlenecks will limit system performance.
- Customers embrace multi-vendor storage solutions.
- SANs allow heterogeneous shared storage subsystems.



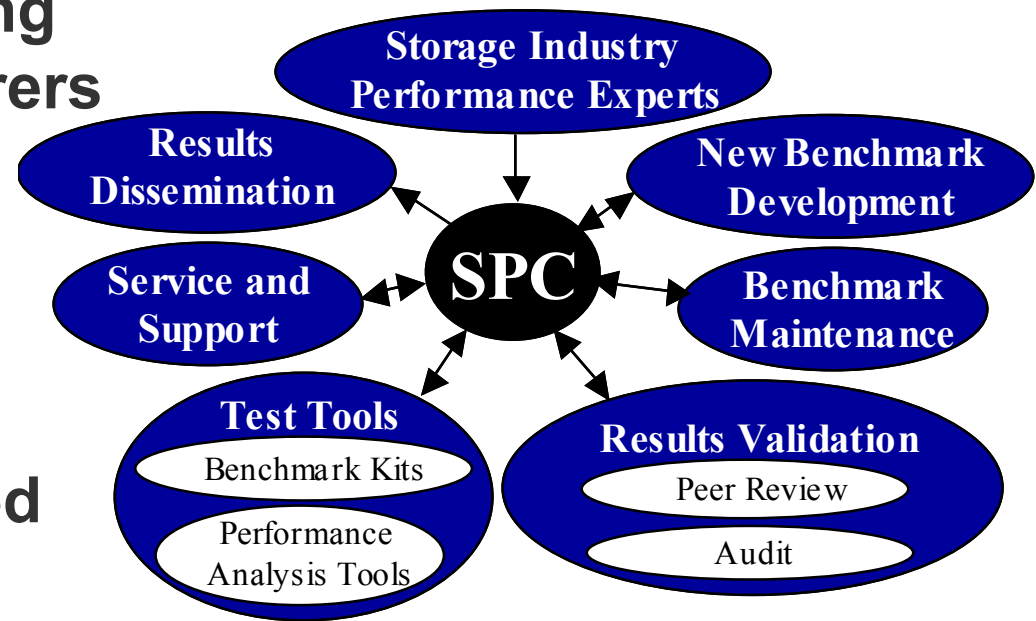
# Council Mission

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- The SPC is a non-profit corporation founded in 1998 to
  - define, standardize, and promote the first industry standard storage benchmarks
  - to disseminate objective, verifiable performance data
  - to developers, product managers, and customers of computer systems

# SPC Objectives

- Drive performance improvement in the computer systems industry for storage
- Insure that customers can accurately compare products in a multi-vendor world
- Establish a level “playing field” for all manufacturers
- Publicize benchmark results
- Ensure accuracy and authenticity of published results





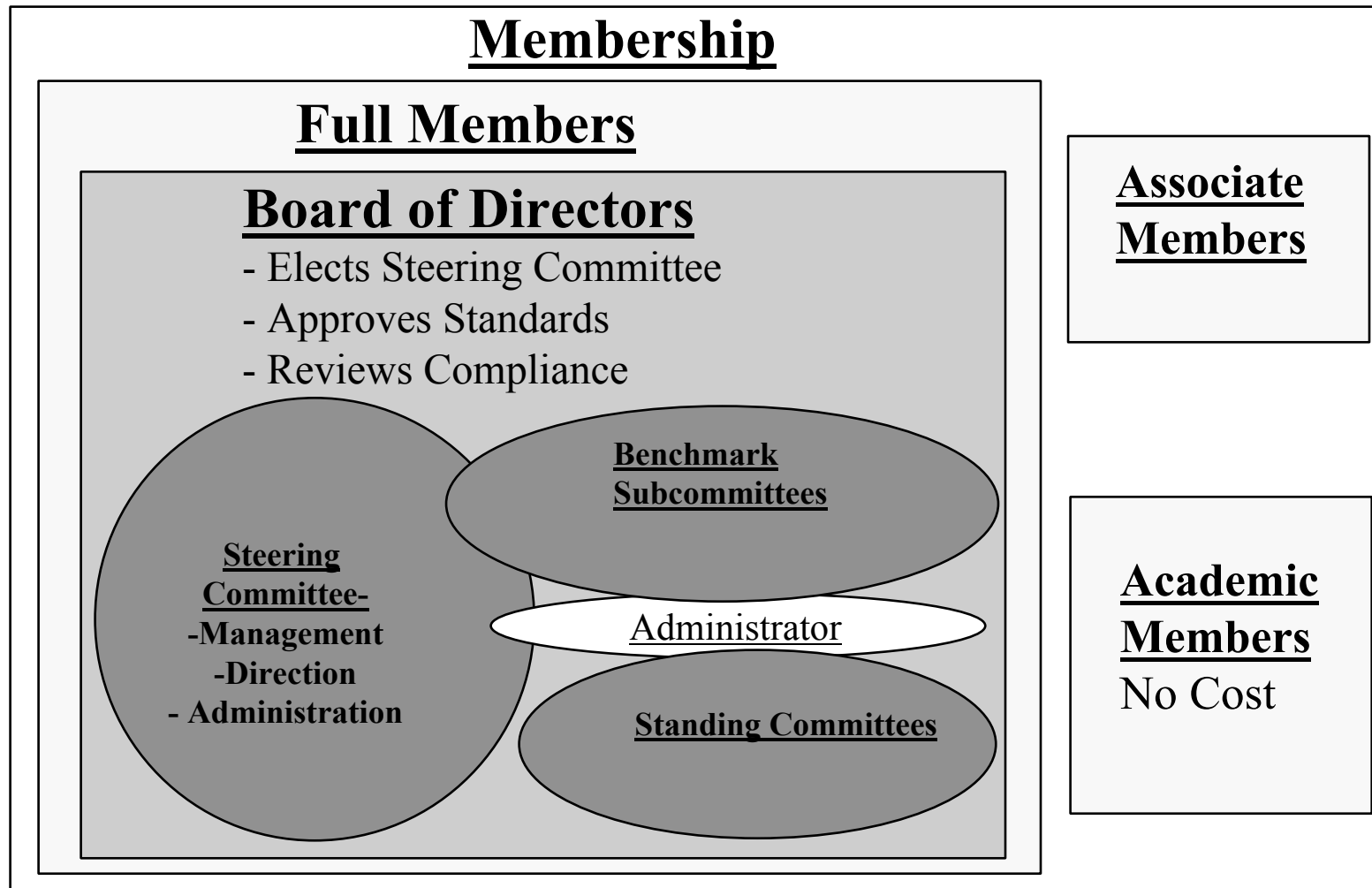
# SPC Membership

•Full	•Associate	•Academic
•Adaptec	•3PARdata	•Florida Atlantic
•Compaq	•Cisco	Univ
•Dell	•DataCore	
•Fujitsu	•Data Storage Inst.	
•HP	•Fidelity Investments	
•Hitachi (HDS)	•Intel	•Preferred Analysts
•IBM	•NEC	•Evaluator Group
•LSI Logic	•Platypus	•Ideas International
•Network Appliance	•Qlogic	
•Sun	•Seagate	
•StorageTek	•Spirent	
•Unisys	•Yotta Yotta	
•Veritas		

December 10, 2002 **The companies in blue are new members for 2002.**



# SPC Organizational Structure





# Organizational Update

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- Release of SPC-1 benchmark kit
  - Results publications by the membership started in May
  - Public release of the kit – **AVAILABLE NOW**
- SPC-2 Workgroup is established
  - Early stages of defining the workload.
  - You have the changes to influence it's future.
- Increase in membership
  - 4 new full members
  - 11 new associate members
  - 1 new academic member

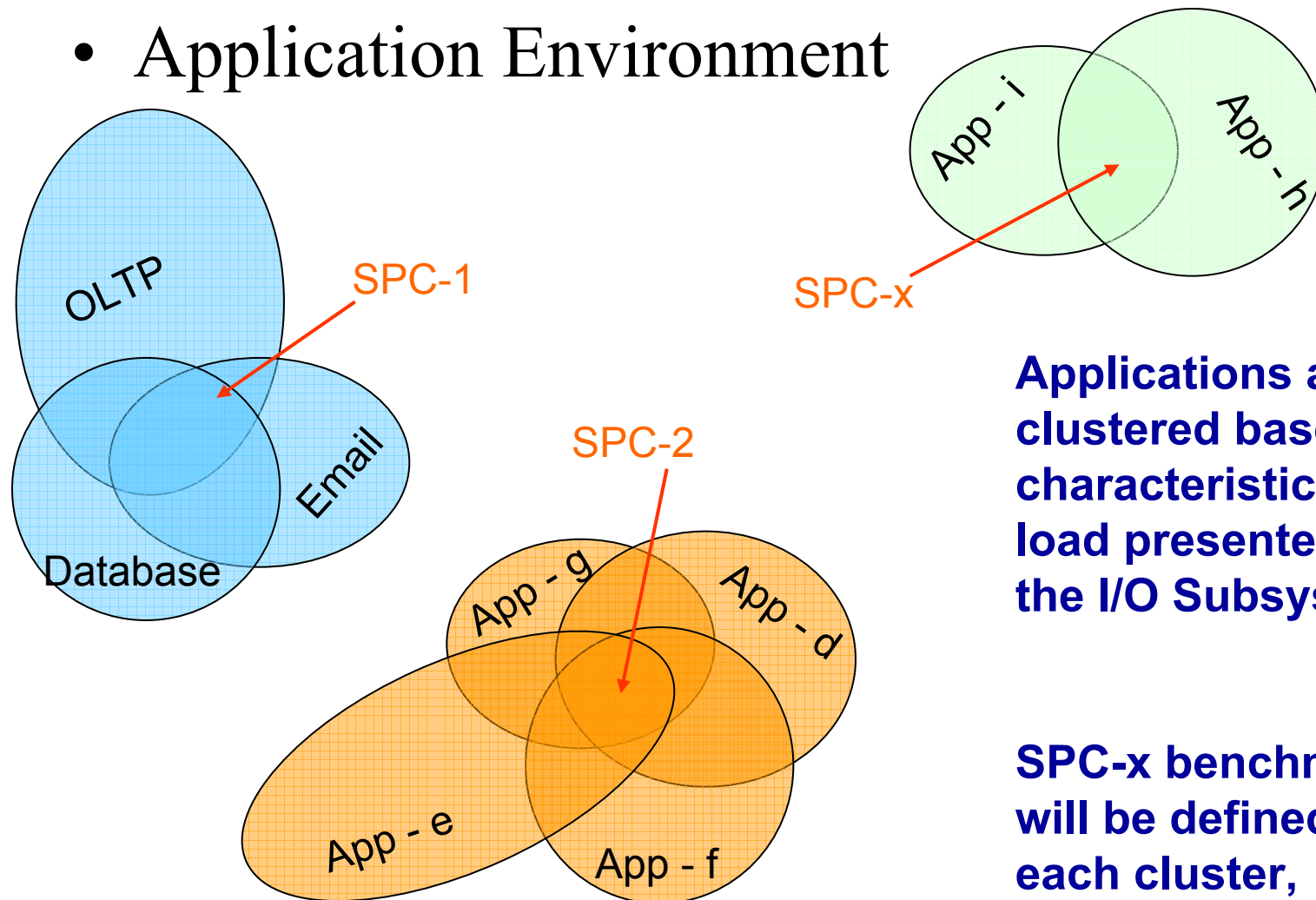


# SPC-1 Benchmark

Mel Boksenbaum

# *SPC Benchmark-1™ Vision*

- Application Environment



**Applications are clustered based on characteristics of load presented to the I/O Subsystem**

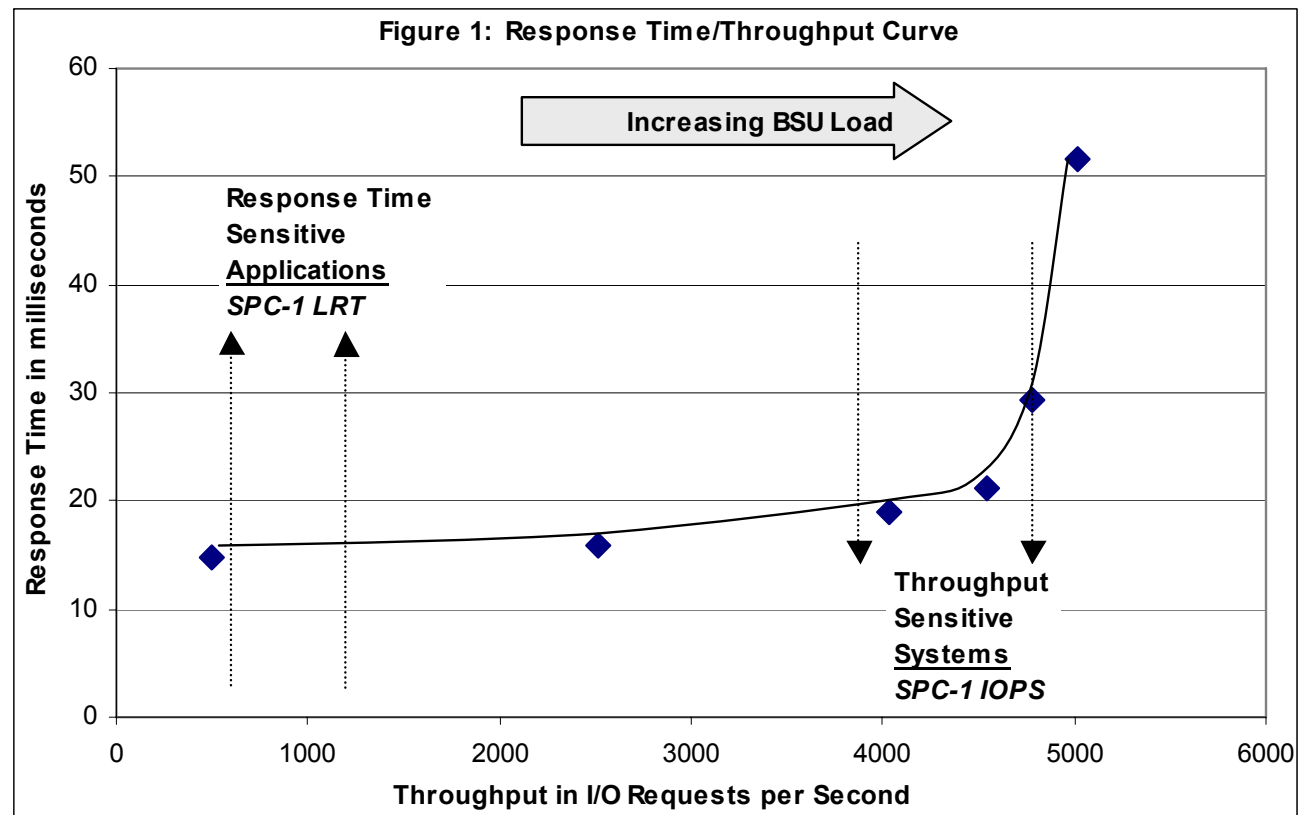
**SPC-x benchmark will be defined for each cluster, starting with SPC-1**



# SPC Benchmark-1™ Vision

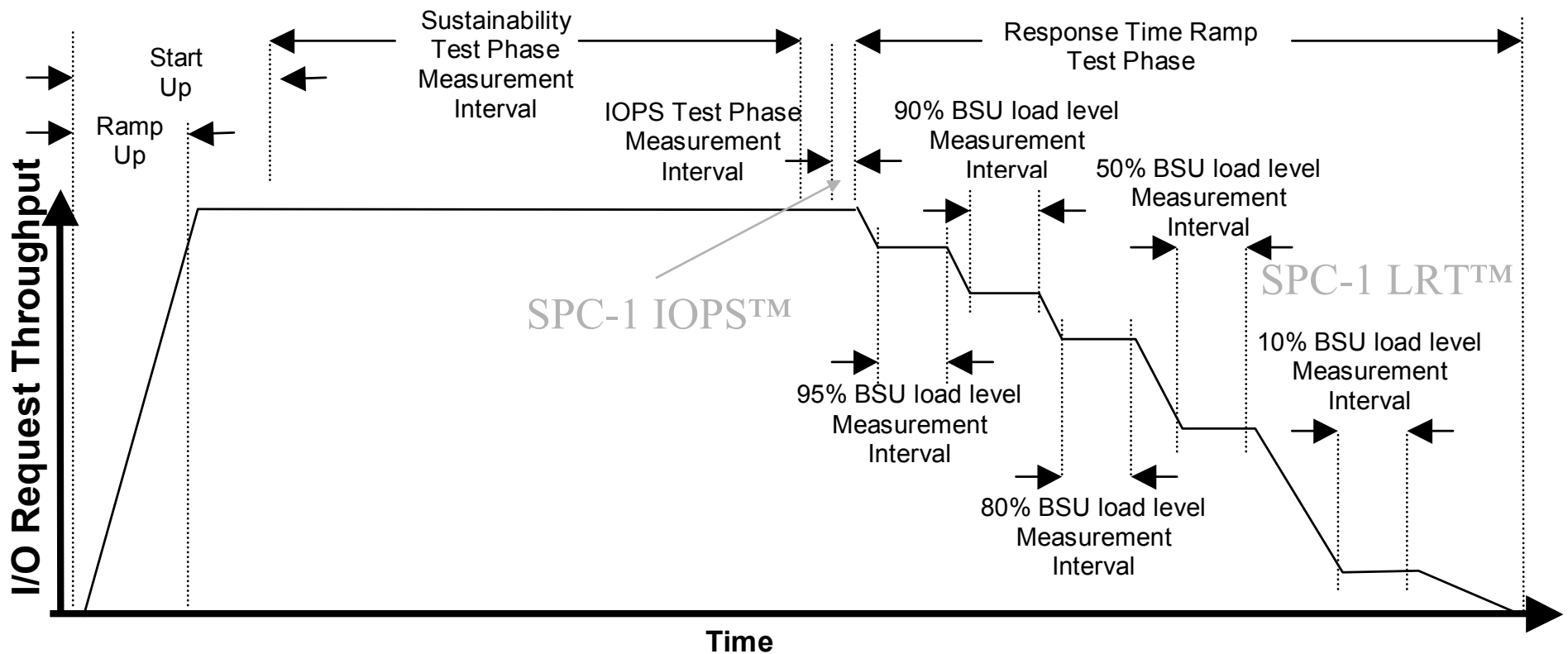
- **Important Metrics**

- SPC-1 IOPS (Maximum Throughput)
- SPC-1 LRT (Best Response Time @ lite load)
- Price
- Capacity
- Data Protection



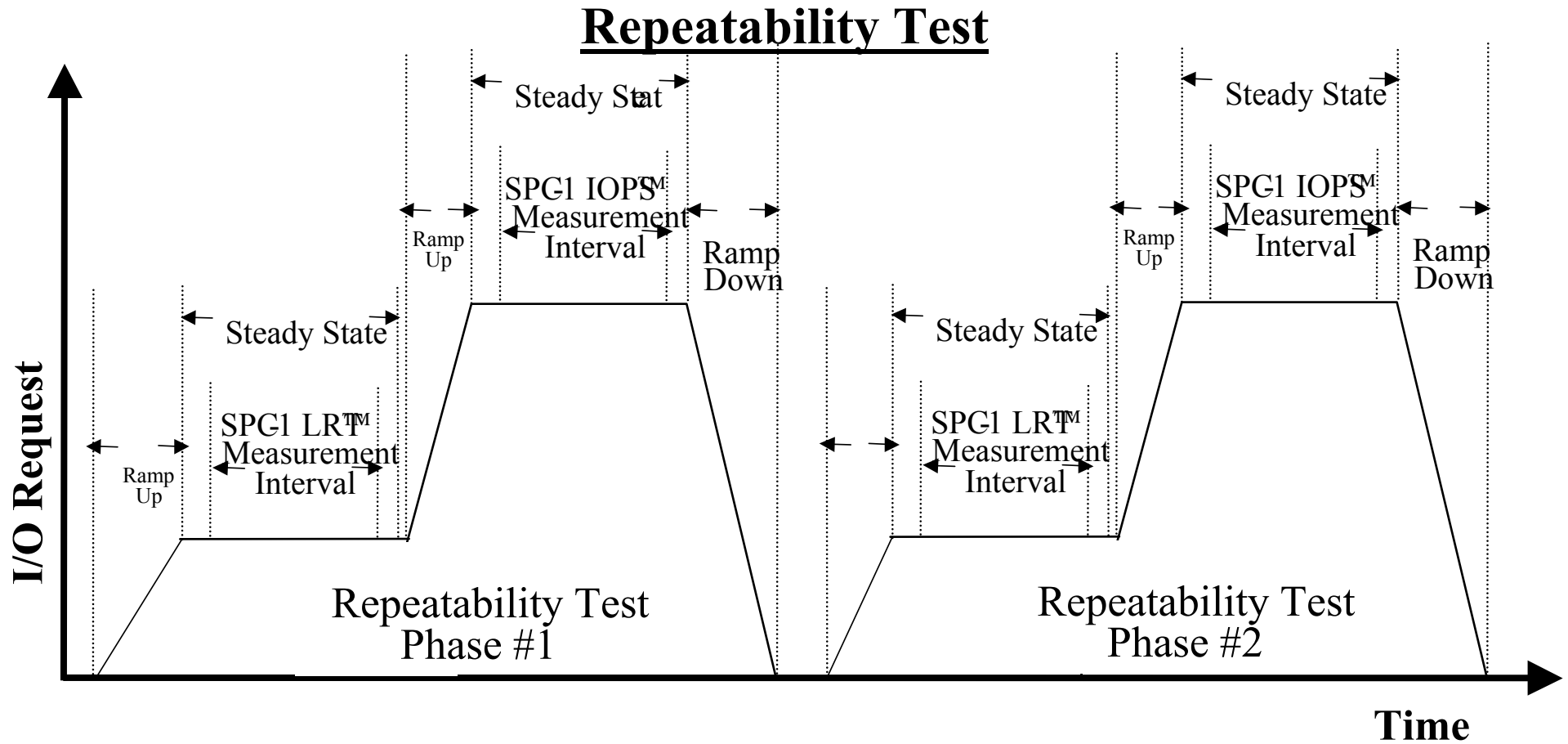
# SPC Benchmark-1™ Vision

- Metric Test Components



- & Repeatability & Data Persistence

# SPC Benchmark-1™ Vision

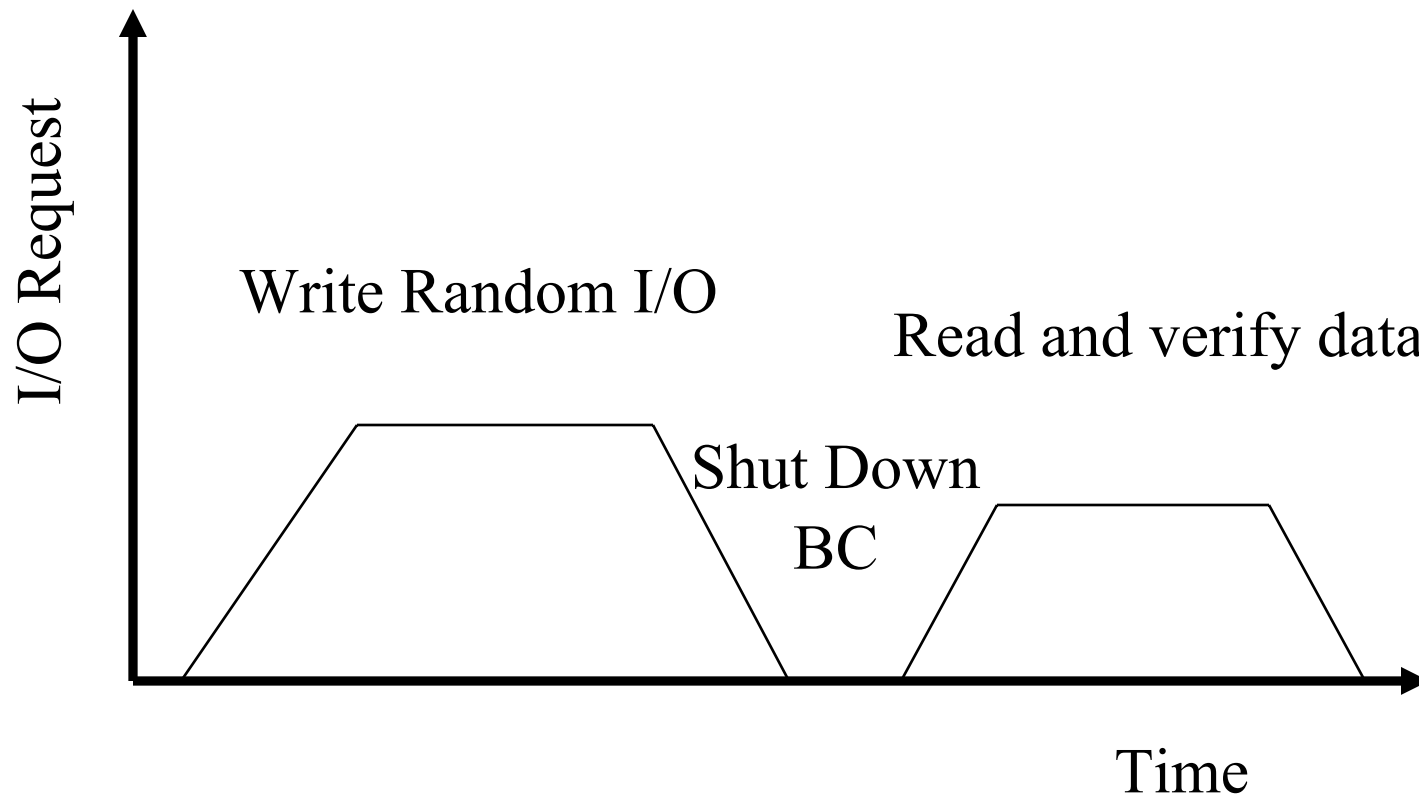




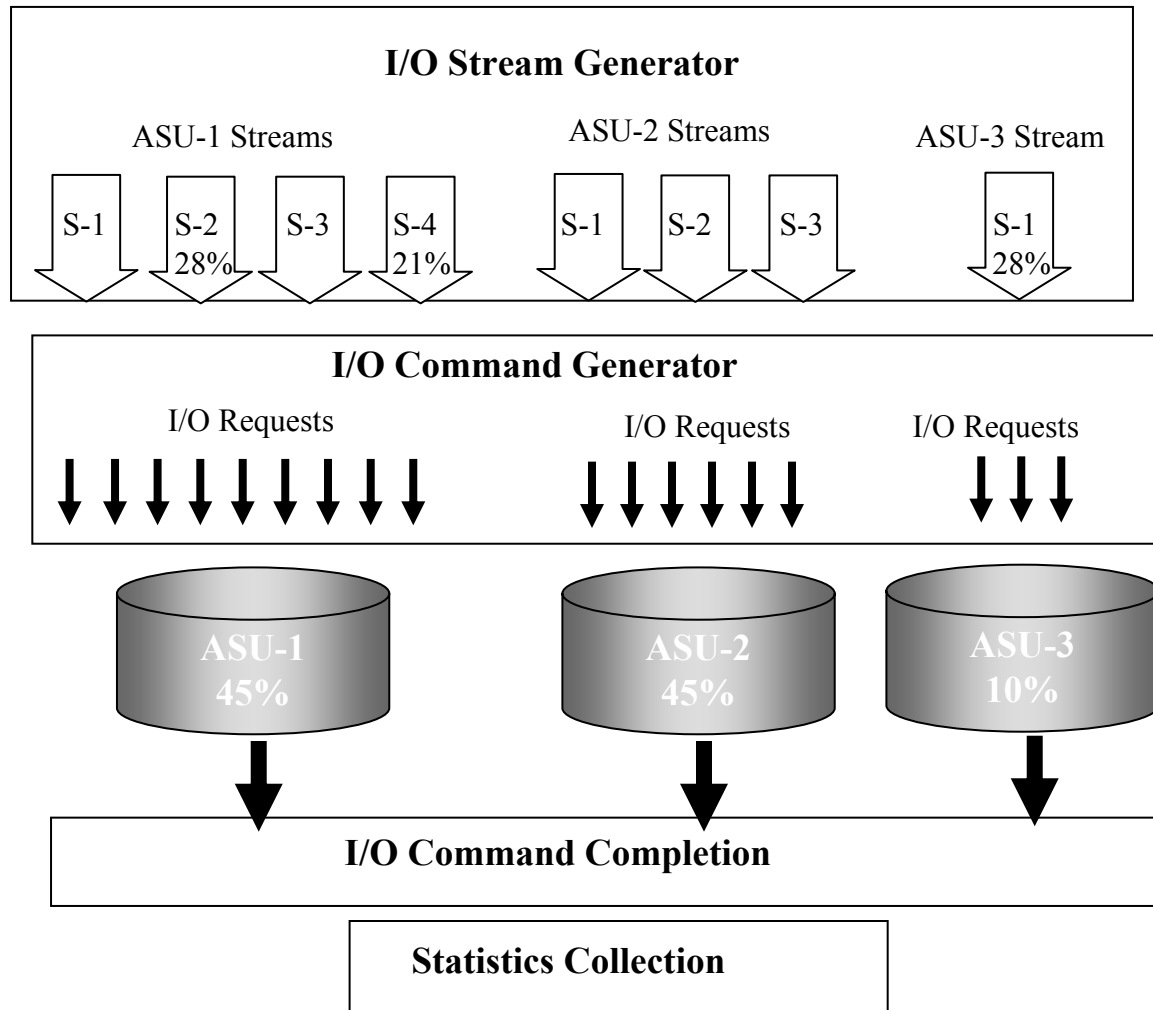
# *SPC Benchmark-1™ Vision*

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## Data Persistence Test



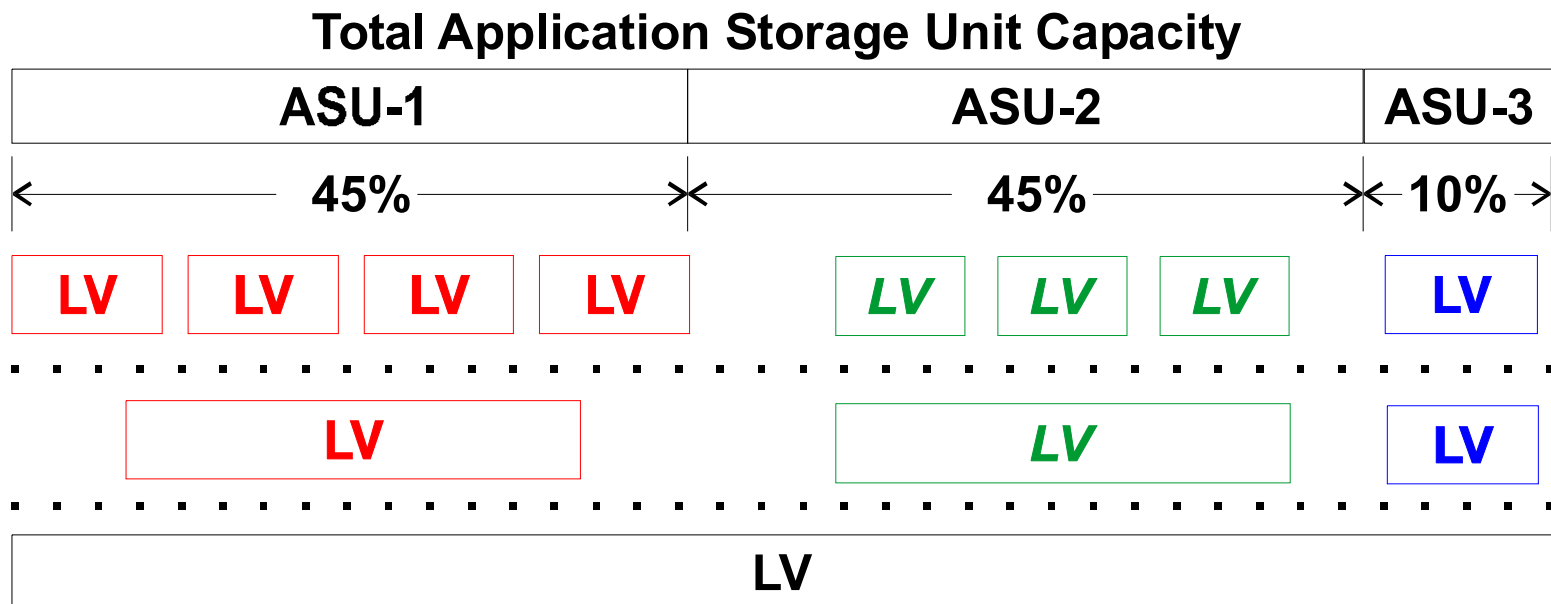
# Structure of SPC-1 I/O





# Running The SPC-1 Benchmark

- Tested Storage Configuration (TSC)
  - Must conform to the Specification





# *Running The SPC-1 Benchmark*

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- Tested Storage Configuration (TSC)
  - Must conform to the Specification



## *About The Benchmark Kit*

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- **SPC-1 benchmark kit includes:**
  - Benchmark executables & scripts
    - Solaris
    - Windows 2000
    - AIX
    - HP/UX
    - Linux
  - Results summary & FDR Production tools
  - Documentation

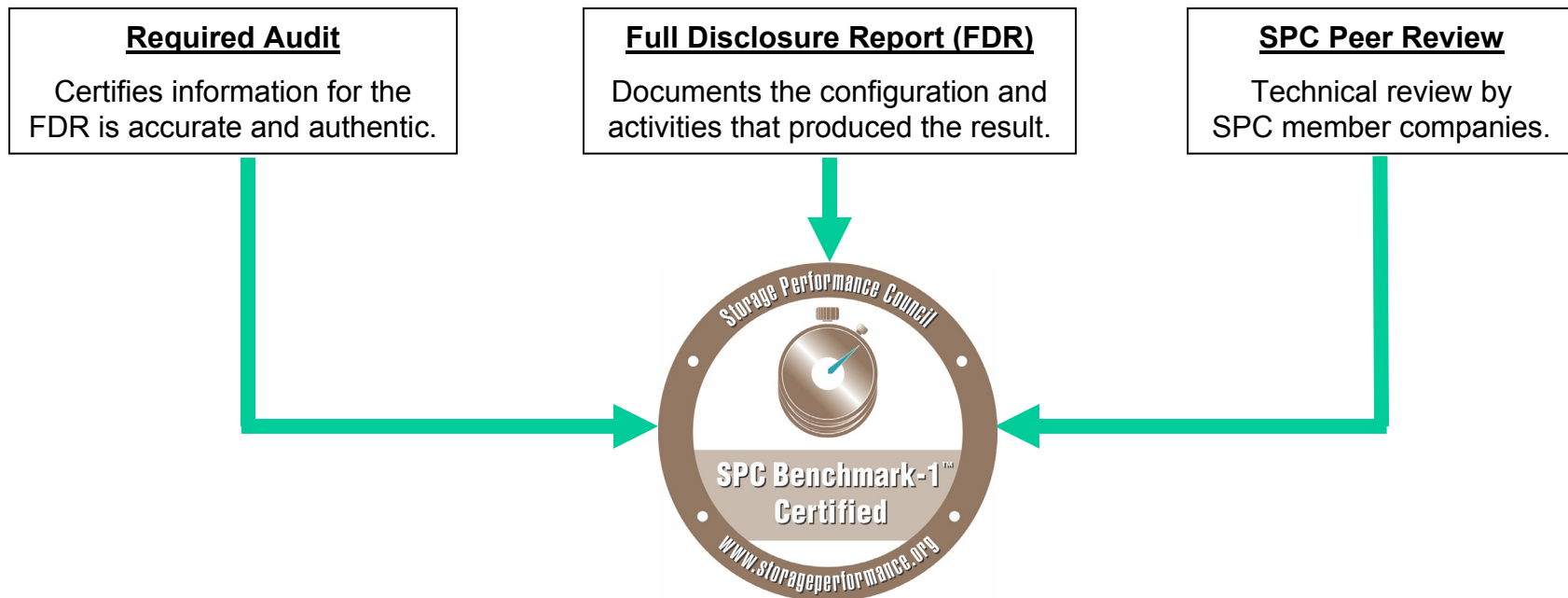
***SPC-1 Results:  
Audited & Official, what does that mean  
and what can I do with it?***

Walter E. Baker

# SPC-1 Results Validation

## – The SPC-1 Results Validation Process

- Successful completion of the three components listed below produces an official, approved SPC-1 Benchmark Result.





# SPC-1 Results Validation

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## – Required Audit

- Certifies the information produced for the FDR is accurate and authentic based on the specification.
  - Benchmark Configuration (BC)
  - Benchmark measurements and results production
  - Pricing and availability
- Audits are provided by the SPC Auditing Services
  - The SPC Administrator – Gradient Systems, Inc.
- Two type of audits:
  - On-site
  - Remote



# SPC-1 Results Validation

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## – Required Audit

- On-Site Audit: The Auditor is physically present during benchmark execution and information collection.
  - Required when a Test Sponsor has failed a Remote Audit or submitted a non-compliant result.
- Remote Audit: The Auditor is not physically present.
  - Results files (digitally signed) and other required materials are submitted to the SPC Auditing Service.
  - The SPC Auditing Service ensures completeness, authenticity, and accurateness.



# SPC-1 Results Validation

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## – Full Disclosure Report (FDR)

- Documents the results, procedures, configuration and equipment used to produce the benchmark result.
- The FDR will allow replication of the benchmark result given appropriate documentation and products.
- Also includes:
  - An audit certification letter issued by the SPC Audit Service
  - A Letter of Good Faith issued by the Test Sponsor
    - » An assurance of fidelity and candor even if not explicitly required by the current benchmark specification.



# SPC-1 Results Validation

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## – SPC Peer Review

- A 60-day period after the result has been submitted to the SPC.
- SPC member companies may raise issues of compliance during this review.
  - An exchange of information may resolve an issue.
  - In that case, no formal action is taken or recorded.
- Unresolved issues are forwarded to the Compliance Review Committee (CRC).



# SPC-1 Results Validation

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## – SPC Peer Review

- The Compliance Review Committee (CRC) will provide one of the following recommendations:
  - Compliant, Insignificant Deviation, or Non-Compliant
- The SPC will vote on the CRC recommendation.
  - **Insignificant Deviation:** The result remains an official SPC-1 result but must include a update with the finding.
  - **Non-Compliant:** The result is removed from the SPC-1 results directory and cannot be used or referenced by the Test Sponsor.



# SPC-1 Results Validation

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## – SPC-1 Results Validation

- Ensures accurate, compliant, authentic benchmark results.
- Ensures comparable benchmark results
  - Given two storage solutions that do not have identical hardware and software components, but both appropriate for the same environment, SPC-1 provides a means to compare the two solutions.



# Using SPC-1 Results

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- **The Executive Summary and Full Disclosure Report (FDR) are the sources of SPC-1 Results data:**
  - The Executive Summary is a ‘high-level’ overview containing key data.
  - The Full Disclosure Report contains all of the configuration and execution detail for the benchmark measurement.
    - The FDR will provide enough detail to recreate the configuration and measurement.



# Using SPC-1 Results

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## – **Primary metrics:**

- SPC-1 IOPS™
- Total ASU Capacity
- SPC-1 Price-Performance

## – **Other required information:**

- SPC-1 LRT
  - Response time at 10% of the reported load, NOT at the reported SPC-1 IOPS™ level (100%)
- Data Protection Level
  - RAID5
  - Mirroring
  - Unrestricted



# Using SPC-1 Results

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## – Other required information:

- Response Time / Throughput Curve
  - Discussed in the next presentation

## – Storage

- Physical Storage Capacity
- Configured Storage Capacity
- Addressable Storage Capacity
- Total ASU Capacity



# Using SPC-1 Results

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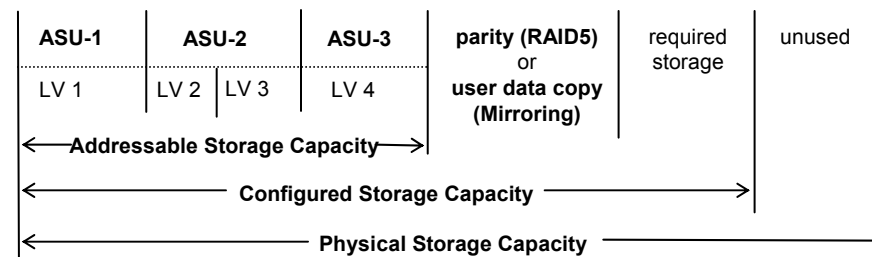
- **Physical Storage Capacity**
  - The storage present during the benchmark
- **Configured Storage Capacity**
  - Addressable Storage Capacity plus any storage required to implement the Addressable Storage Capacity
- **Addressable Storage Capacity**
  - The total storage that can be read/written by the SPC-1 Workload Generator
- **Total ASU Capacity**
  - The actual storage read/written by the SPC-1 Workload Generator



# Using SPC-1 Results

## – Storage Capacities and their Relationships

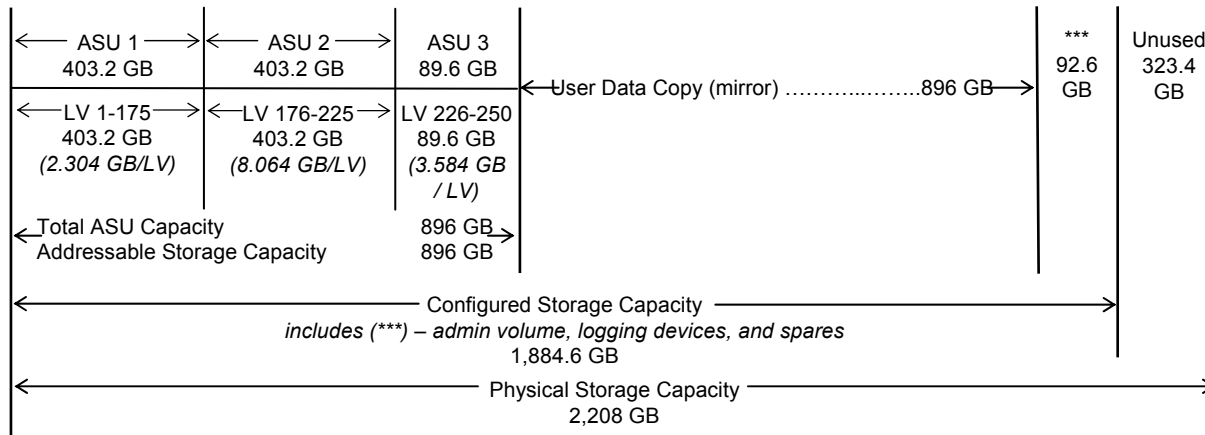
- Diagram is required for the Full Disclosure Report (FDR)
- Provides insight into overhead required and “short stroking”



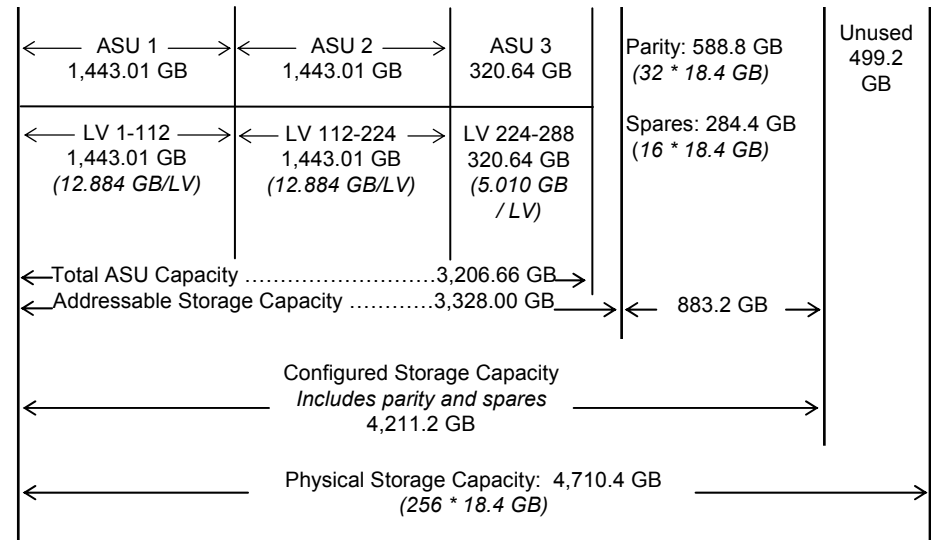


# Using SPC-1 Results

## – Storage Capacities and their Relationships



**85.35%**



**89.40%**



# Using SPC-1 Results

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## – Required Pricing

- Total price including 3-year support/maintenance
- Price-performance (Total Price/SPC-1 IOPS<sup>TM</sup>)

## – Other metrics can be calculated

- \$ per storage capacity
  - Physical
  - Configured
  - Addressable
  - Total ASU



# Using SPC-1 Results

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- **The Full Disclosure Report (FDR) and Executive Summary are the “keys” to understanding and comparing SPC-1 results.**

# *SPC-1 results*

Randy Kerns



# Performance for Storage

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- Some customers have specific requirements
  - % of workload is performance sensitive
  - May mean difference in getting work done in allotted time
- Most storage systems will satisfy basic needs
  - Some variations
  - Want to understand how one compares to another
  - Vendor claims may not represent “meaningful” environment



# Posted Results

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- Understand categories of products
  - What capabilities are there besides performance
  - Configuration and attribute settings effect on results
- View in overall context – performance, cost, etc.
  - Use to determine which products satisfy your requirements



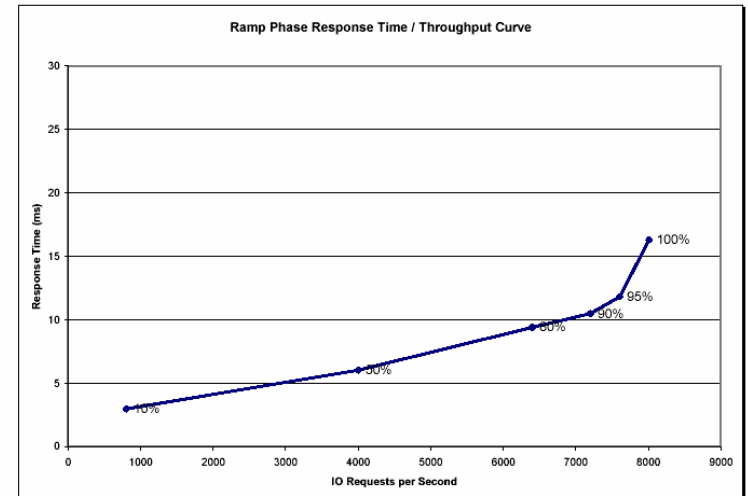
# Posted Results

Vendor / Product	Type	Storage Protection	Disk Used	Addressable Capacity	I/O's per second	SPC-1 LRT	\$/IOP
Dell Perc3/QC	Entry Level Array	Mirror	56 SCSI 18GB 15K rpm	540 GB	7,650	3.10 ms	\$4.48
HP EVA	Distributed Storage	Mirror*	168 FC 36GB 15K rpm	2,596 GB	24,006	2.29 ms	\$19.99
HP EVA	Distributed Storage	Mirror	168 FC 36GB 15K rpm	2,596 GB	20,097	2.36 ms	\$23.88
IBM ESS 800	Cache-centric	RAID 5	256 SSA 18GB 15K rpm	3,207 GB	22,999	2.53 ms	\$34.88
IBM ESS F20	Cache-centric	RAID 5	64 SSA 36GB 15K rpm	1,201 GB	8,009	2.99 ms	\$44.48
LSI E4600	Distributed Storage	Mirror*	112 FC 18GB 15K rpm	400 GB	15,708	1.64 ms	\$16.01
Sun 9910	Cache-centric	Mirror	48 FC 73GB 10K rpm	344 GB	8,404	2.07 ms	\$74.29
3Par InServ S800-2	Clustered Distributed Storage	Mirror	120 FC 18GB 10K rpm	896 GB	12,906	2.62 ms	\$19.73
3Par InServ S800-8	Clustered Distributed Storage	Mirror	640 FC 18GB 10K rpm	4,444 GB	47,001	2.34 ms	\$24.90

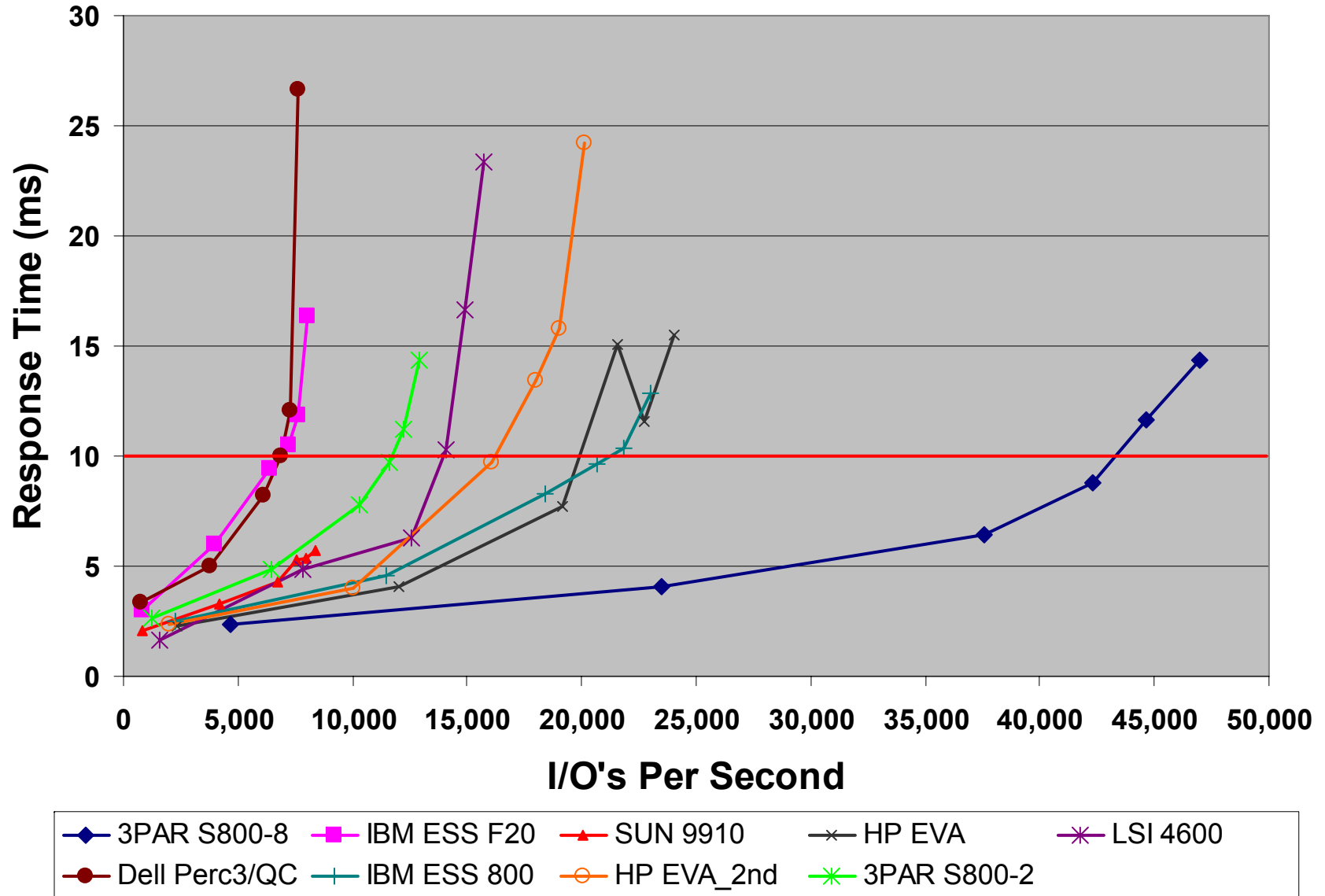


# Issues to Consider for Results

- Capacity and features for test run
  - Valid configuration options explanation
- I/O's without exceeding 30ms
  - Some devices may have performance where 30ms isn't reached with test
- LRT is response time at 10% of workload
  - Want a graph showing response time vs. I/O's where knee of curve is evident



# SPC Posted Benchmark Results 12/9/02



# *Futures Direction*

Peter Dreisbach



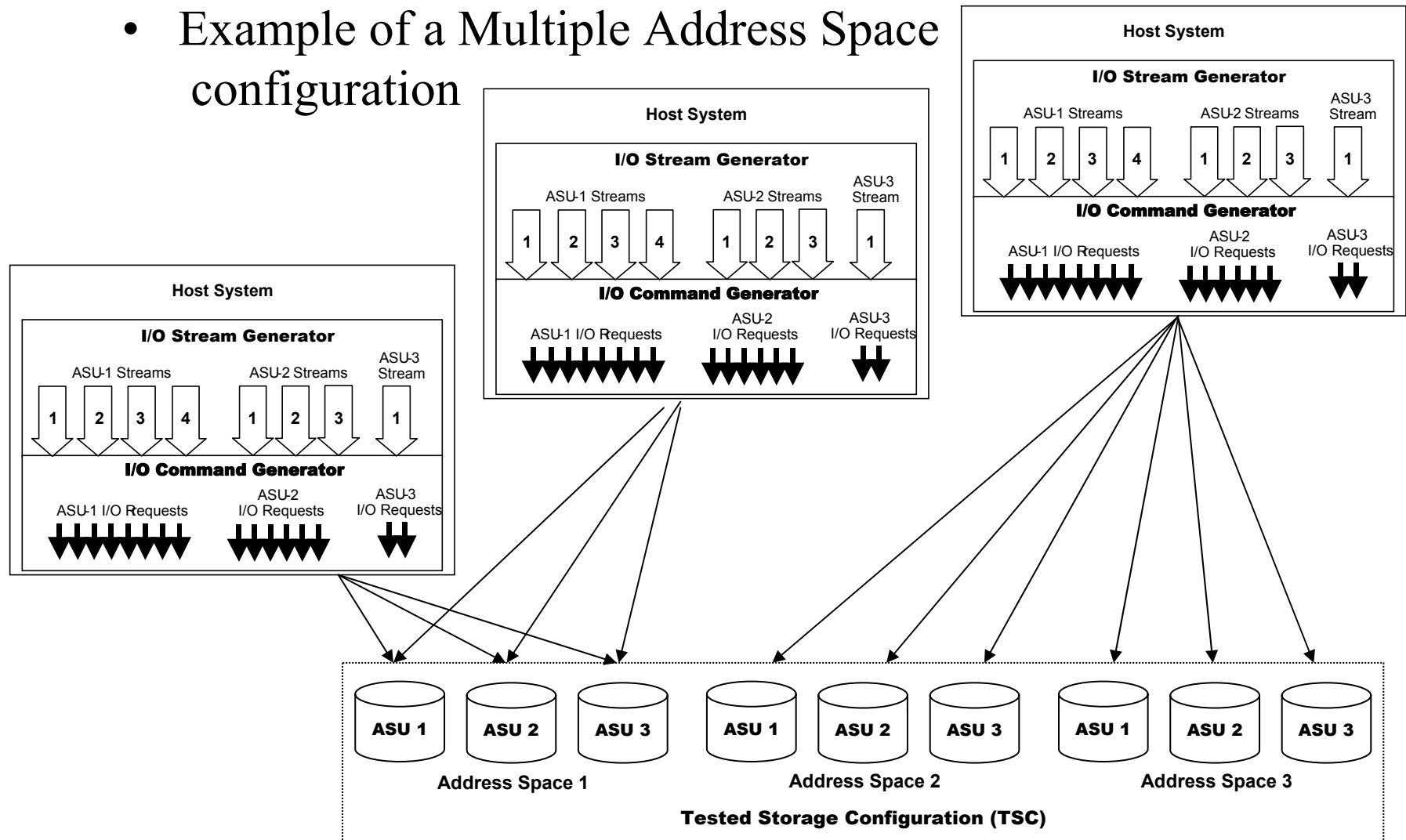
# SPC Next Steps

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- SPC-1 Multiple Address Space Configurations
  - Issue: Members have expressed a need to measure multiple applications/services using a common storage subsystem.
  - Issue: Some Storage products provide space much greater than usable by the current Benchmark
  - Solution: Allow multiple sets of ASU spaces.
    - Most likely driven by multiple hosts
    - Will likely require Toolkit modifications

# SPC Next Steps

- Example of a Multiple Address Space configuration





# SPC Next Steps

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- SPC-2 Benchmark
  - Currently gathering traces for analysis
    - Internet Image Download
    - Data streaming applications
    - Variant may benchmark Video download
    - Sequential workload



# SPC Next Steps

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- Beyond SPC-2?
  - Network Attached Storage (NAS) Benchmark
- What are your Benchmark needs?
  - Visit us at the Evaluator Group booth
  - Contact us at [spcadmin@storageperformance.org](mailto:spcadmin@storageperformance.org)



# SPC Next Steps

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- Trace Data Archive
  - Standard format
  - Translation tools



# Questions

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